Innovative Tools and Methods for Assessing Children's Potential Chemical Exposures

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Research

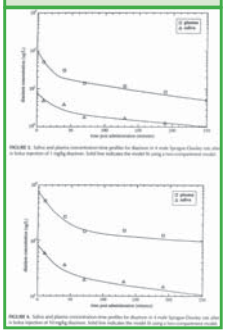
Children's exposures to environmental contaminants are different than adults, due in part, to differences in physiologic function, surface-to-volume ratio, and the way in which children interact with their environment (i.e., sitting on the floor, eating off the floor, hand-to-mouth activity). Therefore, the tools and methods used to assess exposure for adults can't be directly applied to children. Although research on children's exposure to environmental contaminants is being performed within EPA, academia, industry, and other research organizations, protocols that have been developed by individual researchers for specific studies do not always collect all of the data required for reliable exposure assessments, and the data collected can not always be interpreted. Prior to the work undertaken by ORD, standardized protocols for conducting exposure field studies that provided useful data for measurement-based exposure assessments did not exist. Likewise, protocols for developing exposure factor data to be used for modeling assessments were not available. The development of innovative tools and methods for assessing children's pesticide exposures are integral to ORD's human health research program. In order to evaluate whether a subpopulation can be considered to have differential risks, tools and methods that are capable of measuring differential risks must be developed and tested. Numerous tools and methods have been developed by ORD to characterize children's pesticide exposures. Development of these innovative tools and methods puts ORD on the leading edge of the exposure and risk assessment fields. In addition, it allows ORD to reduce health risks by working closely with community stakeholders, industry, and academia to share these tools and methods. This poster highlights the innovative tools and methods that have been developed and used by ORD in its research program.

Research Organizations

- Columbia Center for Children's Environmental Health at the Columbia University School of Public Health, Frederica Perera, PI
- Mount Sinai Center for Children's Environmental Health and Disease Prevention Research at the Mount Sinai School of Medicine, Mary Wolff, PI
- Center for Child Environmental Health Risks Research at the University of Washington, Elaine Faustman, PI
- Center for Children's Environmental Health Research at the University of California at Berkeley, Brenda Eskenazi, PI
- Center for Environmental Health Sciences, College of Veterinary Medicine, Mississippi State University, Mississippi State, Janice Chambers, PI

Methods/Results

- **A saliva biomonitoring technique** for measuring pesticide exposures in young children
  - > Improves participant compliance
  - > Reduces burden
  - > More acceptable to parents (as compared to a blood sample, for example)



(Lu et al. 2003)

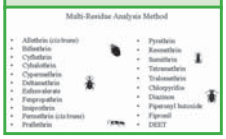
(Courtesy of Asa Bradman at UC-Berkeley)

- **Children's Dietary Exposure Methodology**
  - > Improves dietary measurements for children by incorporating excess exposures due to handling
  - > More accurate intakes can be calculated to estimate total dietary exposures of children

- **Draft Protocol** for Measuring Children's Non-Occupational Exposure to Pesticides by all Relevant Pathways (US EPA 2001. EPA/600/R-03/026)
  - > Provides guidance for generating data that can be used to improve exposure assessments for young children
    - * Framework
    - * Exposure algorithms and data needs
  - > Provides approaches and methods that can be used for conducting field studies to collect exposure measurement data and to develop exposure factors
    - * Fills a critical need for standardized approaches and methods
    - * Facilitates comparison of data

- **Cotton garments, socks and hand wipes** for measuring dermal exposure
  - > Improves our understanding of chemical residues on children's skin during normal activities
  - > Minimal burden to participant

- **A multi-residue multi-media** analysis method



- **Novel global positioning system technology**
  - > Characterizes child activity patterns
  - > Captures and understands children's activities with less burden

Elgethun et al. 2003

- **Urine collection method** using commercially-available disposable diapers
  - > Improves participation
  - > Easy to collect and store for the field technician and participant

Average Efficiency of Extraction of Metabolites from Diapers

Metabolite	Extraction Efficiency (%)*
3-PBA	76
4F-3PBA	76
cis-DMCA	58
trans-DMCA	62
cis-DCCA	81
trans-DCCA	82
DBCA	71
CIAA	89
TCPy	102
IMPy	79
Creatinine	104

*Average for all tests, N=25

- **Glove protocol**
  - > Improves the ability to estimate children's potential pesticide exposures from their pets

Impact and Outcomes

- ORD research program has developed numerous innovative tools and methods that have been shared with other groups, including
  - > EPA's Program Offices
  - > Other Federal Agencies
  - > Researchers in academia and industry
- Glove protocol has been incorporated into the revised pesticide exposure guidelines for use in the pesticide registration process
- Environmental health policy changes in Washington, California, and Minnesota have resulted from this research
- On-going exposure and environmental epidemiology studies are using these validated methods

Conclusions

- Numerous tools and methods have been developed within the ORD human health research program to characterize children's pesticide exposures
- Development and current evaluation of a Protocol for evaluating children's aggregate exposures to chemicals
- Validation of a method for collecting urine samples using commercially-available diapers to analyze for pesticide metabolites
- Evaluation of a non-invasive saliva biomonitoring method using rat models showing the relationship between saliva and plasma chemical levels
- Refinement of methods for collecting and analyzing dust samples
- Development and evaluation of a glove protocol method to assess pesticide exposures from pets
- Evaluation of a visual child activity diary to improve collection of time activity data from targeted populations
- Use of a new global positioning system technology to characterize child activity patterns in order to collect relevant time activity data
- Evaluation of methods to use cotton garments for estimating dermal exposure
- Development and evaluation of a "lunchbox" for air sampling
- Validation of a multi-residue multi-media analysis method for pyrethroid pesticides
- Improved methods for surface sampling

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